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ELASMOSAURID SKULL FROM THE LOWER CRETACEOUS OF QUEENSLAND (REPTILIA: SAUROPTERYGIA).

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ABSTRACT

A nearly complete, but badly crushed skull of an elasmosaurid, probably *Woolungasaurus glendowerensis,* has been collected from near Richmond, Queensland. It is the first skull of a long-neck plesiosaur from Australia. Attribution to *W. glendowerensis* is made on the basis of associated vertebral centra. The distal portion of a very large left humerus (LO 4018) found near the Flinders River, previously provisionally attributed to *Kronosaurus,* is in fact an elasmosaurid humerus.

INTRODUCTION

The family Elasmosauridae of the suborder Plesiosauria is represented by numerous fossils from Cretaceous marine sediments in most regions, and many more or less valid genera and species have been created (Welles 1952, 1962; Persson 1963). However, most of these fossils are parts of the postcranial skeleton (vertebrae, girdle bones, limb bones etc.). As far as the author is aware from the literature, only eight specimens with skulls have been described hitherto, the one here dealt with (QM F11050) being the ninth. A tentative explanation of the scarcity of skulls is given below: the elasmosaurs were, as we know, extremely long-necked animals, so long-necked as a matter of fact that for their necks to be mobile their heads had to be small. Therefore the cranial bones were thin and delicate, and not likely to be preserved in the sediments. Besides, perhaps in many cases the heads were simply snapped off and swallowed by big sharks or carnivorous marine reptiles, such as the huge pliosaurid *Kronosaurus.* Then the headless carcasses drifted around, and when the flesh decomposed or was eaten by scavengers the bones sank to the bottom and were imbedded in the sediments.

It is true that the specimen QM F11050, because of its crushed and distorted condition, does not give much new information about the Elasmosauridae, but the facts gathered are valuable in that they corroborate our general knowledge of the family. Furthermore, the specimen is the only elasmosaurid skull known from Australia, and one of the few known from the world as a whole.

I wish to thank the Board of the Queensland Museum and the curator of geology, Dr Mary Wade, for giving me access to this unique material. I am indebted to Dr Ralph E. Molnar, editor of the *Queensland Museum Memoirs,* for stratigraphical information and for his contribution of the history of the specimen. During my young days Australia was my 'dream country' and so it still is. Hence I am particularly happy to have an opportunity to add a little contribution to the knowledge of its prehistoric fauna.

HISTORY OF THE SPECIMEN

The specimen was originally discovered by Mr T. Noonan of Maxwelton, north Queensland, in a disarticulated state in the bed of Yamborra Ck. (variously spelled) near Crowfels outstation, north of Maxwelton. Presumably the specimen had derived from the Toolebuc Fm. through which Yamborra Ck. has excavated its bed. Mr Noonan had found a block with cranial remains and a number of vertebral centra and generously donated to the Geological Survey of Queensland the cranial block and three of the vertebrae. The cranial block included the posterior two-thirds of both skull and jaws, rather distorted and crushed.

The site was later (first week of July, 1976) visited by a joint field party of R.E. Molnar, R.A. Thulborn and M. Wade, who recovered two more vertebral centra (QM F12219) and the anterior portion of a skull. R.E. Molnar (at the time at the University of New South Wales, Sydney) returned with the portion of skull to Sydney to identify it. This portion of skull eventually came to be catalogued at the Australian Museum (AM F60056). In the meantime, before the site was revisited, the posterior portion of the skull had been sent to the author for description. While at the Australian Museum the anterior portion of the skull was recognised by the Keeper of Fossils, A. Ritchie, as pertaining to the same specimen as that sent to the author. It was then transferred to the Queensland Museum and catalogued as QM F11050, and photographs were forwarded to the author. The posterior portion of the skull was then also transferred to the Queensland Museum, and, as it fitted the anterior portion, given the same number.

To clarify the convoluted history of this material here is a precis of the specimens and their catalogue numbers: skull and mandibles, QM F11050 (anterior portion previously AM F60056, posterior portion previously GSQ F10552); cervical centrum, QM F12216 (previously GSQ F10550b); a ventral impression in matrix of QM F12216 with two small pieces of bone, QM F12218 (previously GSQ F10550a); two adherent cervical centra from a position posterior and probably not adjacent to QM F12216, QM F12217 (previously GSQ F10551); and, two associated centra, not in contact, QM F12219.

COLLECTION DESIGNATIONS

AM	— Australian Museum, Sydney
GSQ	— Geological Survey of Queensland, Brisbane
QM	— Queensland Museum, Brisbane
UCMP	— University of California Museum of Paleontology, Berkeley

Order SAUROPTERYGIA
Suborder PLESIOSAURIA
Family Elasmosauridae Cope 1869
Genus *Woolungasaurus* Persson 1960

Woolungasaurus cf. *W. glendowerensis* Persson 1960

MATERIAL. Badly crushed skull and mandible in two pieces (QM F11050); 5 vertebral centra (QM F12216, QM F12217, and QM F12219); ventral impression of one centrum with bone fragments (QM F12218). See "History of the Specimen."
GEOLOGICAL HORIZON. Toolebuc Limestone (?).
LOCALITY. Yamborra Creek, near Richmond, north Queensland.

DESCRIPTION

SKULL.

As is clear from the history above it is the posterior part of the skull (QM F11050 Pl. 1) which was hitherto available to the author. The anterior part is broken off near the anterior margin of the orbits. The skull is depressed (sheared) from the left to the right side, and is so badly crushed and deformed that in most cases it is impossible to identify the sutures between the different elements, and to get accurate measurements. The entire length of the fossil, from a point in the fracture just between the anterior margins of the orbits, and to the posterior articular face of the adherent atlantoaxis, is 273 mm. The greatest breadth is 143 mm. Because of the deformation these measurements give only an approximation of the original proportions of the skull. The length of the rostral (preorbital) portion is 155 mm. Hence the length of the entire skull plus the atlantoaxis is estimated at about 42 cm.

Both orbits are strongly deformed. The lacrimal bone forms the anterolateral part of the orbital margin, and the postorbital bone forms the posterior margin. Judging from the conditions of the left orbit, which is less deformed than the right, the margin formed by the two elements mentioned was almost a semicircle. The length (i.e. the rostrocaudal diameter) of the left orbit in its present state is 78 mm. The posterior parts of both maxillae are preserved, but it is impossible to find their sutural delimitations. The frontals are strongly dislocated, pressed together, forming an elevated ridge between the orbits. Whether the frontals originally formed the dorsomedian orbital margins, as is the case in *Alzadasaurus colombiensis* Welles, 1962, or whether these margins were formed by the prefrontals cannot be seen.

Just behind the orbits is a partly covered, flat bone fragment with what seems to be a median suture. The present author has apprehended (though with some hesitation) this fragment to be the hindmost part of the frontals. If my interpretation is correct the frontals extended further posteriorly in the present species than in any other elasmosaur for which the skull is known. Only a little part of the parietals can be seen. They

had apparently a low but sharp parietal crest. Both squamosals are so badly crushed that nothing can be said about their original shape, and this is also true of the maxillae and the jugals, though the maxillary-jugal suture can be partially traced at the left side. The quadratojugals meet the jugals in an almost vertical suture. The quadratojugal-squamosal suture is, if correctly identified, situated about 8 cm above the quadrate-quadratojugal suture.

In the present species the quadrates are comparatively small bones. They are, as far as can be seen, very similar in shape to the corresponding elements of *Alzadasaurus colombiensis* (see Welles 1962, p. 19; figs. 3, 4). The right quadrate is still connected with the quadratojugal, and its articular condyle lies in its natural position towards the articular face of the mandible. Therefore the breadth of the condyle cannot be directly measured. It is estimated at 2·5 cm. The quadrate-quadratojugal suture is irregularly shaped but distinct. The left quadrate is dislocated anteriorly about 9 cm. It lies close to the median side of the left mandibular ramus, and it is partially covered by matrix and unidentified bone fragments.

Since the atlantoaxis is still in situ, the occipital condyle cannot be studied. All other elements in the occipital, basal and palatal regions of the skull are also covered, either by more or less dislocated bones or by matrix.

The hyoids are preserved. This may be only the second find of plesiosaurian ceratobranchials. The first was in the type specimen of *Alzadasaurus colombiensis* (UCMP 38349; Welles 1962, p. 21; see also Romer 1956, p. 420). The right hyoid is the better preserved. It is 101 mm. long, rod-like, and slightly curved, partly imbedded in the matrix. Its breadth is 7–8 mm. The exposed side is somewhat flattened. Both end faces have, at least as far as can be determined from what is exposed, an oval circumference and are slightly concave. Only the posteror part of the left hyoid can be seen. The parts of the mandible are, as the other remains of the cranial skeleton, crushed and deformed. The right ramus is the best preserved. Its greatest dorsoventral depth is 62 mm. At its anterior fracture its depth is estimated as 42 mm. At this point the lateromedial section is 15 mm. broad.

The angular is displaced. The supraangular-dentary suture is clearly visible, but other sutures cannot be identified with certainty.

THE DENTITION.

In the anterior portion of the skull and mandible there are 40 teeth or tooth sockets exposed (10 in the right maxilla; 11 in the left; 9 in the right mandibular ramus; 10 in the left). In the rostral portion of the skull are 32 teeth or tooth sockets. Of these 4 are in the left premaxilla and 3 in the right, 5 in the right maxilla and 4 in the left, and 8 in each dentary. Thus the animal had, if my interpretations are correct, about 18 teeth in each side of its upper jaw and about 18 in each dentary. Anyway, the number is uncertain because of the possible presence of obscured teeth and/or alveoli.

Only the crowns are exposed, and most of them are incomplete. However, it is quite clear that they do not differ from the general form from those of other elasmosaurids (and, for that matter, other dolichodiran plesiosaurians: Welles 1943, 1952, 1962; Persson 1959, 1967; and other authors). The crowns preserved are high and slender, and slightly recurved lingually and posteriorly. In parabasal section they are roughly elliptical with their labial sides somewhat less convex than the lingual ones. The ornamentation consists of delicate apico-basal ridges, which at least on the labial sides are confined chiefly to the basal part the upper part of the crown being more or less smooth. The best preserved maxillary crown has a height of 24 mm, and the height of the best preserved mandibular one is 22 mm. The basal diameters are 9·5 mm and 9 mm respectively. The teeth in the skull and mandibular portions available to me are remarkably uniform as to size, in this respect differing from the dentition in the elasmosaurs described by Welles (1943, 1952, 1962).

ROSTRAL PORTION OF THE SKULL AND MANDIBLE.

The present author has not seen this part of the specimen but has received excellent photos of it. The portion consists of the premaxillae, the anterior part of the maxillae, the nasals(?), and the rostral part of the mandibula (Pl. 1). It is, like the rest of the skull, depressed (sheared) from the left to the right. Its length from the tip of the snout to fracture is, at the approximate midline, 155 mm, and its greatest breadth (near the fracture) 143 mm. Because of the deformed state of the fossil the breadth measurement gives only a very rough idea of the original breadth.

The narial openings are strongly deformed and displaced. However, it is clear that they were comparatively small, as is the case in most of the dolichodiran plesiosaurs. They were situated about 1·5 cm before the orbits.

The premaxillae join the maxillae in a distinct suture. On the right this suture can be easily traced. It runs from the narial opening obliquely forwards and downwards and meets the alveolar line about 6 cm behind the tip of the snout. The dorsal face of the premaxillae is slightly concave, which may have given the beast a somewhat "snub-nosed" appearance. The nasals cannot be identified. Probably they are fused to the lacrimals and/or the premaxillae without a traceable suture.

The mandibular symphysis is well exposed. Its length is about 75 mm.

VERTEBRAE.

The atlantoaxis, as mentioned above, is adherent to the skull, fixed to the occipital region by matrix. Thus matrix obscures the anterior part of the atlantoaxis so its length cannot be measured. On the ventral and left lateral faces the atlantoaxial suture is visible (most of the right lateral face is obscured by matrix). The fact that the suture is not obliterated by synostosis might indicate the individual to have been fairly young but for the fusion of the cervical arches and the large size of the specimen. Since the neurapophysis is broken off the neural canal is well exposed. Its width is 12 mm. No foramina for nutritive vessels can be seen. On the ventral face there is a distinct median keel. This is highest (about 1 cm) on the atlantal part of the face, and slopes down and flattens out at the axial part. The posterior articular face is slightly concave. Its height is 31 mm and its breadth 33 mm.

Three vertebrae (QM F12216 and F12217) all of them apparently from the middle of the neck, are available for study. The measurements and indices of their centra are given in Table 1. Two adherent vertebrae both numbered F12217 are still in the natural relation to each other, held together by matrix. F12216 is the foremost of these three vertebrae. There are at least one, possibly two or more, vertebrae missing between F12217 and F12216. F12218 is not a vertebra but a piece of matrix which forms a natural cast of the ventral face of F12216.

TABLE 1: MEASUREMENTS AND INDICES OF THREE CERVICAL CENTRA OF *WOOLUNGASAURUS* CF. *W. GLENDOWERENSIS*.

	Length mm	Height mm	Breadth mm	H:L ind.	B:L ind.
QM F12216	91	75	93	82	102
QM F12217 ant.	98	85	105	86	107
QM F12217 post.	100	87	107	87	107

The neurapophyses as well as the cervical ribs are fused to the centra without any sign of a suture. In all three vertebrae the distal parts of the spinal processes and the cervical ribs are broken and lost. The width of the neural canal in F12217 is 24 mm and its height 21·5 mm. The end faces (articular faces) are slightly concave and have sharp rims. A typical feature of the anterior and middle cervical vertebrae in elasmosaurs is the presence of a pair of lateral longitudinal ridges. These ridges are distinct in all three vertebrae.

DISCUSSION

All characteristics of taxonomic value observed in the specimen are, as may readily be gathered from the literature (Welles 1943, 1952, 1962; Persson 1963; and other authors), clearly elasmosaurid. However, the generic and specific determinations are somewhat questionable. In the nearly contemporaneous *Woolungasaurus glendowerensis* Persson 1960 (a huge elasmosaur from the same region of Queensland) the major part of the skeleton is known, with the exception of the skull.

The generic and specific diagnoses are based upon features of the vertebrae, girdles and limb bones (Persson 1960, p. 11–2). Since the girdles and limbs are missing in the material here under discussion, a comparison with the *W. glendowerensis* type specimen (QM F3567) must be limited to the vertebrae. The three middle cervical vertebrae here available are all a little larger than those in the corresponding region of the type specimen (Persson 1960, p. 13, table 4), but the proportions of their centra are very similar to those of the holotype (cf. Table 1). The two later-found vertebrae (QM F12219) look indistinguishable from the type vertebrae of *Woolungasaurus glendowerensis* (Molnar, pers. comm. 1981). In view of these facts the author supposes the Yamborra specimen to belong to the genus *Woolungasaurus* Persson 1960 and, with reservation, to the type species, *W. glendowerensis*.

As mentioned in the introduction, relatively few skulls of elasmosaurs are known and most of them, like the present one, are crushed and more or less deformed. As a consequence detailed discussion is of little value. If my interpretation of the skull bone fragments is correct the frontal bones extended further posterior in the present form than in any other elasmosaur for which the skull has been described. This would possibly be of taxonomic interest.

The unusual uniformity in size of the teeth of the specimen here described has probably no taxonomic significance. Perhaps we are seeing a consequence of sexual dimorphism, one sex (♀?) having a rather uniform dentition, the other a more irregular one, with a few large, more or less tusk-like teeth among the others in the rows. The occurrence of this specimen (QM F11050, QM F12216–9) in the Toolebuc Fm., while the holotype of *W. glendowerensis* is from the underlying Wallumbilla Fm. is not considered to be of significance.

Family Elasmosauridae Cope 1869
Woolungasaurus? sp.

MATERIAL. Distal part of left humerus, in the Paleontological Institute of the University of Lund, Sweden; Cat. no. LO 4018. Previously described as indeterminable by the author (Persson 1960, p. 20).

GEOLOGICAL HORIZON. Probably Albian (probably either Toolebuc Fm. or Allaru Mudstone).

LOCALITY AND FIND HISTORY. In 1958, the author saw the fossil for the first time. It then lay in a stone heap ('rock garden') at Boree Park stn near Richmond, Queensland. A few years earlier it had been collected from a limestone outcrop near the Flinders River by Mr W. Graw, then owner of the station. Mr Graw generously presented the fossil to the University of Lund, Sweden.

DISCUSSION

Courtesy of the Queensland Museum, Brisbane, the author has received an excellent cast of the right humerus of the *Woolungasaurus glendowerensis* type specimen (QM F3567). LO4018 (pl. 2, Fig. 1) is part of a somewhat larger bone than the type humerus, but there are no observable differences of taxonomic value. However, the clasmosaurid propodial bones are, as we know, of very generalized form. Hence, it would be unwise to refer without reservation a fossil like this to a given genus or species unless associated with other skeletal material.

In my paper of 1960 I wrote: 'Specimen LO4018 must have belonged to a very large Plesiosaurian, possibly *Kronosaurus*'. As follows from the discussion above the fossil cannot have belonged to *Kronosaurus* or any other pliosaur. There is no doubt about its elasmosaurid affinity. Since *Woolungasaurus* is the only elasmosaurid genus from this region hitherto adequately documented it seems appropriate to refer the present specimen, at least tentatively, to this genus.

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PLATE 1

WOOLUNGASAURUS W. GLENDOWERENSIS

FIG. 1. Skull and mandibula of *Woolungasaurus* cf. *W. glendowerensis* (QM F11050), in anterolateral aspect.

FIG. 2. The same in ventrolateral aspect. Abbreviations: a, articular; aa, atlantoaxis; d, dentary; fr, frontal; hy, hyoid; j, jugal; l, lacrimal; mx, maxilla; o, orbit; p, parietal; po, postorbital; q, quadrate; qj, quadratojugal; sa, supraangular; sq, squamosal.

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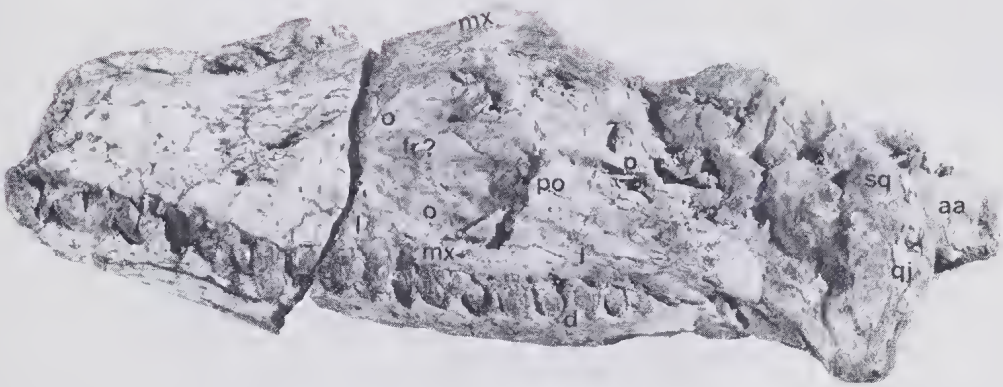

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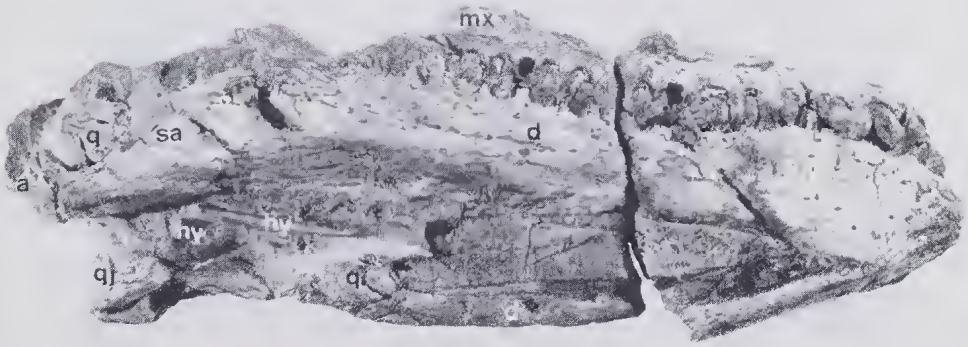

PLATE 2

FIG. 1. *Woolungasaurus?* sp. (University of Lund LO4018), distal portion of left humerus in lateral aspect.

FIG. 2. Model of *Woolungasaurus glendowerensis*, prepared by the author.

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